

2

PATENT ABSTRACTS OF JAPAN

(11)Publication number : 2000-031547

(43)Date of publication of application : 28.01.2000

(51)Int.Cl. H01L 33/00
F21V 13/02
G09F 9/00

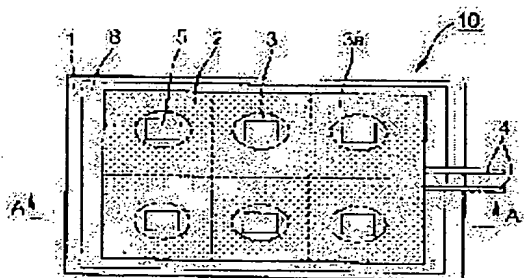
(21)Application number : 10-193508 (71)Applicant : STANLEY ELECTRIC CO LTD
(22)Date of filing : 09.07.1998 (72)Inventor : SANO MICHIIRO
KATO MUNEHIRO

(54) PLANAR LIGHT SOURCE

(57)Abstract:

PROBLEM TO BE SOLVED: To provide planar light source using a LED chip and a wavelength conversion substance which prolongs a life span and has high reliability by a method wherein the sheet-like wavelength conversion substance which has beforehand been formed at a predetermined thickness is arranged in the entire region on a light-emitting diode chip side of a sheet which is subjected to a diffusion process.

SOLUTION: In a stand 1 provided with a reflection frame 2 forming a plurality of recess parts 3, a wiring for supplying a power to each LED chip 5 is provided, and the LED chip 5 is disposed in the recess parts 3 so as to be electrically connected to the wiring and then does not project outwardly from the interior of the recess parts 3. On these front faces, a wavelength conversion sheet and a diffusion plate about on the reflection frame 2 to be laminated so as to coat the recess part 3, and these are sealed with a mold resin 8 to obtain a planar light source 10. Thus, it is possible to reduce the thickness of a wavelength conversion substance, a difference between conversion efficiencies caused by non-uniformity of a distribution, and also a color unevenness thereby, and to obtain the planar light source 10 of a uniform light-emitting color.



[0001]

[Industrial Application] This invention relates to the light source of the surface state used for the back light of an illumination type switch, a display panel, and a liquid crystal display, etc., and in detail, The source of sheet-like light which emits light in a different color tone from the emitted light from a LED tip using the wavelength changing substance aiming at the convert colors of the synchrotron radiation from a light emitting diode chip (a LED tip is called hereafter) is started.

[0002]

[Description of the Prior Art] The electroluminescence (EL) element which is the back light and surface state of an edge light system which allocated the cold cathode tube (CFL) in the end face of a light guide plate as a source of sheet-like light used as a back light etc. which are the conventional liquid crystal displays is used. However, since what used CFL as the light source needs light circuits, such as an inverter, there is a problem of enlarging as a whole. Since the edge light system is used, the problem that the luminosity of a difficult portion far from a light source is low has also obtained the whole uniform light emission. There is a problem that light emitting luminance is dark when EL is used, and it is short-life.

[0003] Then, it excels in a life and the back light which used the light emitting diode (LED is called below) which has the feature of low power consumption as a light source is also proposed. For example, as shown in the thing of the edge light system which has arranged LED instead of the above mentioned CFL, and drawing 5 and drawing 6, LED group 92 of three colors of red (R) green (G) blue (B) is made into one unit, LED group 92 of two or more units is arranged on the planar substrate 91, and there is a thing like JP,63-43177,U made into the source 90 of sheet-like light which established distance and fixed the diffusion board 93 on it.

[0004] However, although this source 90 of sheet-like light is useful as a means for acquiring the white light which contains the emission spectrum of the color of R, G, and B each wavelength band as a back light of a liquid crystal display, Since the synchrotron radiation of each LED which emits light in the wavelength of R, G, and B should be diffused with the diffusion board 93 (refer to drawing 6), unless it established the distance of LED group 92 and the diffusion board 93, the irregular color arose and it was not able to be considered as a homogeneous-mixing color. The adjustment for having to set up so that the luminous region of LED of each color may be in agreement every LED group 92 in order to consider it as a homogeneous-mixing color, and obtaining homogeneous-mixing color luminescence was difficult. In order to have to make it each LED of R, G, and B have to light up with a fixed luminosity, there is also a problem that it must wire so that light control of each LED may be carried out separately. In order to consider it as a uniform mixed color and a uniform luminosity further again, it is necessary to detach a diffusion board and a LED group to some extent for the above-mentioned reason, and to provide, and there is a problem that slimming down of the source of sheet-like light is difficult.

[0005] In order to depend for the radiation color by LED on the material of the LED tip currently used for this LED on the other hand, After dipping into the circumference of a LED tip what distributed the fluorescent substance in resin, resin is hardened, the wavelength of the synchrotron radiation from a LED tip is changed, and the light emitting diode which obtains white light is also proposed.

[0006] Then, the source of sheet-like light was created for LED group 92 shown in drawing 5 as one LED tip. After the fluorescent substance layer 95 which distributed the fluorescent substance is dropped at heat-curing resin as this LED tip is covered around one LED tip which was replaced with LED group 92 and has been arranged so that a dotted line may describe in drawing 6, it is made to harden in that case. The diffusion board 93 is formed in these front faces like drawing 6.

[0007] Since the same LED tip was altogether used in this source of sheet-like light, the problem for obtaining homogeneous-mixing color luminescence resulting from

each color LED tip synchrotron radiation which was described above not being mixed uniformly was solved. However, wavelength changing nonuniformity is among the lights in which wavelength changing was carried out by the fluorescent substance layer 95, and, thereby, it was inferior to the homogeneity of the color. Forming uniformly carries out this in difficulty, and the same thickness as the circumference of the LED tip of a convex configuration hurts its fluorescent substance content resin, Conversion efficiency changes with differences of the thickness at the time of the light emitted from the LED tip passing a fluorescent substance layer, And it seems that it originates in having become fluorescent substance content resin which has not carried out uniform dispersion etc. since the fluorescent substance with big specific gravity sedimented under the resin and hardened at time until it hardens after fluorescent substance content resin was dropped at the circumference of a LED tip.

[0008]

[Problem(s) to be Solved by the Invention]This invention solves an above-mentioned problem, and can use it for the back light of an illumination type switch, a display panel, and a liquid crystal display, etc., and it sets it as the 1st purpose to provide a long life and the source of sheet-like light using a high-reliability LED tip and a wavelength changing substance. It sets it as the 2nd purpose to provide the thin source of sheet-like light excellent in homogeneity.

[0009]

[Means for Solving the Problem]What solves a technical problem by providing a source of sheet-like light which this invention is a source of sheet-like light characterized by comprising the following, and has allocated a sheet shaped wavelength changing material layer beforehand formed in predetermined thickness in an almost all region by the side of a light emitting diode chip of a sheet which performed said diffusion treatment.

A wavelength changing substance which carries out wavelength changing of the light which allocates two or more light emitting diode chips on a base, and is emitted from this light emitting diode chip on a chip of this plurality.

A sheet which performed diffusion treatment.

[0010]

[Embodiment of the Invention]Below, this invention is explained in detail based on the embodiment shown in a figure. Drawing 2 shows typically the A-A sectional view of the source 10 of sheet-like light of drawing 1 for the outline top view of the source 10 of sheet-like light which requires drawing 1 for this invention. Drawing 4 cuts drawing 3 in part about the source 30 of sheet-like light of another embodiment, it lacks and explains the sectional view of the source 20 of sheet-like light of other embodiments, and the same part is explained using identical codes. As shown in drawing 1 and 2, the wiring 4 which supplies electric power to each LED tip 5 is formed in the base 1 which formed the reflection frame 2 which forms two or more crevices 3, and in said crevice 3, as it does not project outside the inside of the crevice 3, LED tip 5 electrically connects with the wiring 4, and is arranged. It laminated so that the wavelength changing sheet 6 and the diffusion board 7 might cover the crevice 3 in contact with the reflection frame 2 in these front faces, and these were closed with the mold resin 8, and the source 10 of sheet-like light has been acquired.

[0011](Reflection frame) In the reflection frame 2, two or more crevices 3 made into earthenware mortar-like shape shall be established so that the light emitted from the LED tip 5 arranged side may reflect in the upper surface, and in it, as for the inclined plane 3a of the shape of an earthenware mortar of this crevice inner surface, it shall have high reflectance. Shall create the reflection frame 2 with metal, and shall carry out mirror surface finish of the inclined plane 3a, or, aluminum which considers it as the inclined plane 3a which consists of white resin so that it may become high reflectance, or creates a reflection frame with metal, resin, etc., and serves as high reflectance in the inclined plane 3a, the method of forming the tunic which consists of

high reflectivity materials, such as metal, such as Ag and W, and oxides, such as TiO_2 , -- high -- it can be considered as the reflection frame 2 with the reflectance inclined plane 3a.

[0012]As shown in drawing 3, the wavelength changing material layer 3b can also be established in the inclined plane 3a of the reflection frame 2. As the wavelength changing material layer 3b, the same material as the wavelength changing material layer 6b used for the wavelength changing sheet 6 mentioned later can be used. If it does in this way, wavelength changing can be effectively done also to the light emitted to the crevice inclined plane 3a, and it will become desirable.

[0013](Base) Various things, such as metal and glass epoxy resin, can be used for the base 1. When it forms using material especially with metaled high thermal conductivity, the heat generated when many LED tips 5 are formed on the base 1 can be conducted efficiently outside, and it is desirable. Both can use the base 1 and the reflection frame 2 also as what formed in the different body also as what was formed in one, and joined both. In order to form the base 1 and the reflection frame 2 in one, it can obtain by cutting and forming the earthenware mortar-like crevice 3 in a glass-epoxy-resin board, for example, or ejecting and fabricating resin to the metallic mold of specified shape.

[0014](Wiring) The wiring 4 is formed in order to supply electric power to each LED tip, and it is formed by performing Cu plating etc. When the base 1 and the reflection frame 2 are fabricated to one, Since it is necessary to form the wiring 4 linked to LED tip 5 in the crevice 3 in the inclined plane 3a, a mask can be given and the wiring 4 can be directly formed in the reflection frame 2 surface which includes the crevice 3 and the inclined plane 3a by the method of continuing and carrying out electroless deposition and electrolytic plating. When the base 1 and the reflection frame 2 are formed in a different body, it fabricates using white resin etc., without forming the wiring 4 by a publicly known method for example, on the base 1 which consists of glass epoxy etc. beforehand, and forming the wiring 4 in the reflection frame 2 so that it may have the crevice 3 by methods, such as injection molding. Then, it joins together by screwing said base 1 and said reflection frame 2 on using adhesion or a screw etc., and fixes and unifies.

[0015](LED tip) The LED tip of a GaN system which emits blue and/or ultraviolet radiation ($\lambda = 370\text{-}500\text{ nm}$), for example can be used for LED tip 5. What formed the luminous layer 5b of a GaN system by the MOCVD method on the translucency board 5a which consists of penetrable sapphire etc. to the wavelength light emitted from a luminous layer, and formed p electrode and n electrode which are not illustrated to the same field side can be used.

[0016]It has connected in this embodiment, without using the wire currently conventionally used abundantly at the electrical link of the electrode of LED tip 5, and the wiring 4. That is, the wiring 4 which formed the vamp for bonding in each of p electrode and n electrode, and was formed in the base 1 via this vamp is electrically connected. The substrate 5a which this shows translucency to synchrotron radiation becomes the upper surface side, becomes what can make the height of the crevice 3 the minimum, and will become desirable. LED tip 5 is not restricted to LED of a GaN system, and can use SiC system LED, ZnSe system LED, GaAs system LED ($\lambda = 630\text{-}850\text{ nm}$), GaAlAs system LED, ZnO system LED, etc.

[0017](Wavelength changing sheet) Change the wavelength changing sheet 6 into the wavelength which changes the wavelength of the irradiation light from LED tip 5 with wavelength changing substances, such as a fluorescent substance, and A wavelength changing substance, What carried out spreading hardening of the wavelength changing material layer 6b can be used on the translucency sheet substrate 6a which consists of sheet shaped resin film or glass etc. what mixed uniformly the resin bond agent holding a wavelength changing substance. The carrier fluid which consists of heat-hardened type resin is made to distribute a wavelength changing substance beforehand, After making it fully stir, slush said carrier fluid into

a die and fixed time settlement is carried out, Carrier fluid can be stiffened after that, a wavelength changing substance can carry out uniform dispersion to the lower part side with high density using specific gravity difference, and the wavelength changing sheet in which the low density wavelength changing element field which low density or a wavelength changing substance is not distributing was formed can also be used for the upper part. It can also be considered as the wavelength changing sheet etc. which carried out laminate molding of the high-density wavelength changing element layer which carried out uniform dispersion of the wavelength changing substance to the low density wavelength changing element layer which low density or a wavelength changing substance is not distributing with high density to specified shape with techniques, such as injection molding.

[0018]As a wavelength changing substance, the ZnS system fluorescent substance etc. which activated impurities, such as copper, for example can be used, ZnS:Cu, Au, aluminum fluorescent substance, ZnS:Cu, aluminum fluorescent substance, a ZnS:Ag fluorescent substance, To ZnS(s), such as ZnS:Ag+(Zn, Cd) S:Cu and aluminum fluorescent substance, Ag, the thing (Zn.) which made various impurities, such as Cu, aluminum, Ga, and Cl, activate, Cd) To S impurities, such as Cu, aluminum, and Ag, using the thing etc. which were made to activate Blue, What is changed into colors, such as white and yellowish green, $\text{NdP}_5\text{O}_{14}$, $\text{LiNdP}_4\text{O}_{12}$, Various kinds of infrared excitation fluorescent substances, such as $\text{Na}_5\text{Nd}(\text{WO}_4)_4$, $\text{aluminum}_3\text{Nd}(\text{BO}_3)_4$, $\text{Cs}_2\text{NaNdC}_{16}$, and SrS, and other various fluorescent substances independently, Or it shall change into different wavelength by using it combining two or more fluorescent substances. Also suppose that wavelength changing is carried out using specified wavelength absorbing matter, such as a color instead of a fluorescent substance, as a wavelength changing substance etc.

[0019](Diffusion board) The diffusion board 7 is what diffuses the irradiation light from LED tip 5, and acquired the uniform light-emitting surface because diffusion treatment gives by various kinds of publicly known methods, such as hairline machining, crepe processing, and dot printing, is formed with a resin sheet etc. and allocated in the wavelength changing sheet 6 surface. As what also installs the diffusion board 7 side by side at the same time it performs diffusion treatment of forming uneven shape also in the translucency sheet substrate surface of the wavelength changing sheet 6, It is also possible to suppose that much more equalization is attained etc., diffusion treatment is performed to the surface of the wavelength changing sheet 6, and change of omitting the diffusion board 7 can also be performed. Although the diffusion board 7 can be allocated in the LED tip 5 side and the wavelength changing sheet 6 can also be carried out the surface side, it is preferred to provide so that the wavelength changing sheet 6 and the wavelength changing material layer 6b which it is still more desirable, and there are more wavelength changing substances, and exists may be located in the LED tip 5 side. It is because it is more efficient to have arranged the wavelength changing substance to the LED tip side so that wavelength changing may be carried out before the irradiation light from LED tip 5 passes through and decreases the inside of other layers. Since the light emitted from the wavelength changing substance in the wavelength changing sheet 6 becomes what is diffused, even if it is a case where the same diffusion board as the former is used, in the invention in this application, it becomes that to which a diffusion effect is raised further, and its homogeneity improves.

[0020](Mold resin) The mold resin 8 is formed so that the base 1 and the wavelength changing sheet 6, and the diffusion board 7 may be covered, and it is formed in specified shape with an epoxy resin etc. It is formed in rectangular shape so that it may become the surface parallel to the diffusion board 7 in drawing 2, but it can be considered as the shape of boiled fish paste as shown in drawing 3 depending on the use, or the lens cut of other shape can also be formed. Between the base 1 and the wavelength changing sheet 6, as LED tip 5 is covered, resin shall be provided, the

base 1 and a wavelength changing sheet shall be pasted up, and the mold resin 8 shall not exist in a wavelength changing sheet surface. Change of forming the mold resin 8 in the periphery edge between a wavelength changing sheet and the base 1, and closing inactive gas, such as Ar, Ne, Xe, Kr, and nitrogen, to the space between a wavelength changing sheet besides the LED tip 5 circumference and LED tip 5 is also possible.

[0021] Hereafter, the concrete example of the invention in this application is described.

(Example 1) In order to give a radiation effect, an insulating layer is printed on the base (2 cm x 3 cm) 1 made with metal, and the wiring 4 is formed so that it may become a predetermined pattern for supplying electric power to LED tip 5. The alignment mark for alignment with a reflection frame is also produced in that case. Next, a metallic bump is formed in each of the electrode of the couple provided on the base 1 which gave wiring 4 at the same side side of GaN system LED tip 5, and as the LED tip board 5a side of an opposite hand serves as the upper surface, it connects many LED tips 5 to the wiring 4 of a prescribed position. Adhesion fixing of the reflection frame 2 made from ceramics processed so that two or more owners of the earthenware mortar-like crevice 3 might be carried out is carried out to the metal bases 1 on the basis of the alignment mark formed in the base 1. It is made for height to be set to 2 mm, and the reflection frame 2 has formed the crevice 3, as the section turns into the inclined plane 3a used as linear shape or parabolic.

[0022] After printing what mixed the ZnS system fluorescent substance 11.2g changed into white light to the translucency epoxy resin 100g which is carrier fluid on the translucency sheet substrate 6a which consists of glass, the wavelength changing sheet 6 was stiffened, and formed and produced the wavelength changing material layer 6b. Then, as the epoxy resin 8 is poured in in the crevice 3 which allocated LED tip 5 and air bubbles do not enter, as the wavelength changing material layer 6b side becomes the LED tip 5 side, it installs and heats said wavelength changing sheet 6 prepared beforehand, the epoxy resin 8 is stiffened, and adhesion fixing is carried out. The white polycarbonate film diffusion board 7 which performed crepe processing was allocated in the upper surface of the wavelength changing sheet 6, and also the source 10 of sheet-like light as shown in drawing 1 and drawing 2 was acquired by closing them with the epoxy resin 8, as these are covered. In this way, when the power supply was connected to the acquired source 10 of sheet-like light, uniform white light was obtained, and the display with a good place which used this source of sheet-like light as a back light of a liquid crystal display was obtained.

[0023] (Example 2) The source 20 of sheet-like light as changed the mold resin shape etc. of the source 10 of sheet-like light of Example 1 mentioned above and shown in drawing 3 is produced. The wavelength changing material layer 3b was established in the inclined plane 3a of the reflection frame 2 on the same conditions as the conditions formed in the wavelength changing sheet. Shape of the wrap mold resin 8 was made into the shape of boiled fish paste for the source 20 of sheet-like light, as shown in drawing 3, and what printed the predetermined color specification pattern was further used for the diffusion board 7. The source 20 of sheet-like light as shown in drawing 3 like Example 1 was produced except it. In this way, when the power supply was connected to the acquired source 20 of sheet-like light, uniform white light was obtained and this source 20 of sheet-like light was made into the indicator of a lighting switch, the switch with which view ** of the foreground-color pattern formed in the diffusion board 7 is carried out good was obtained.

[0024] (Example 3) Although the mold resin 8 is filled up with Example 1 mentioned above in the crevice 3, in this example, the source 30 of sheet-like light as enclosed inactive gas and shown in drawing 4 is produced. As each crevice 33 estranges the crevice 33 made into the shape of an earthenware mortar to the 2-mm-high reflection frame 32, it forms it in it. Adhesion fixing of this reflection frame 32 is carried out to

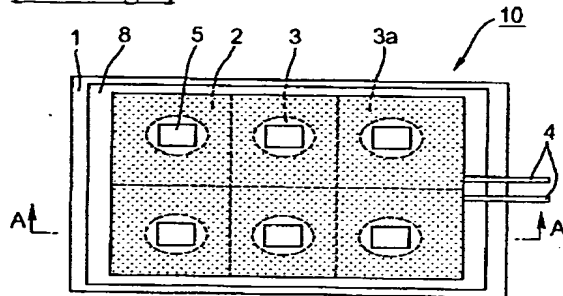
the base 1 furnished with LED tip 5 of Example 1. As the side which provided the wavelength changing substance in the upper flat surface of said reflection frame 32 becomes the wavelength changing sheet 6 which joined the diffusion board 7 into the atmosphere which consists of mixed gas of Ar and Xe the LED tip 5 side, it Next, the adhesives for vacuums, For example, adhesion fixing is carried out using trade name Torr-Seal made from U.S. Varian. Furthermore, with the epoxy resin 8, as these were covered, they were closed, and the source 30 of sheet-like light was produced. In this way, luminescence of the good uniform color was obtained like [the acquired source 30 of sheet-like light] the source of sheet-like light of Example 1.

[0025]

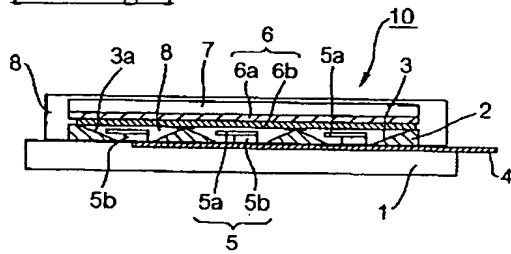
[Effect of the Invention] Since the wavelength changing sheet which was beforehand set as the thickness of a wavelength changing substance and the value of a request of density, and was formed is used according to this invention as explained above, The conversion efficiency difference and the color unevenness according to it further resulting from the thickness of a wavelength changing substance and the unevenness of distribution can be reduced remarkably, and the source of sheet-like light of the uniform luminescent color can be acquired. The diffused light arises with a wavelength changing element sheet, it can be considered as much more uniform luminescence by providing the diffusion treatment layer which diffuses the diffused light further, and the effect which was excellent in the ability to make thin thickness of the whole source of sheet-like light is done so.

DRAWINGS

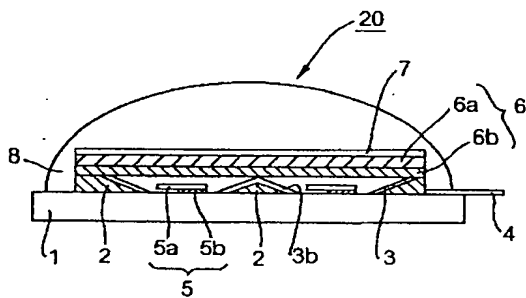
[Drawing 1]



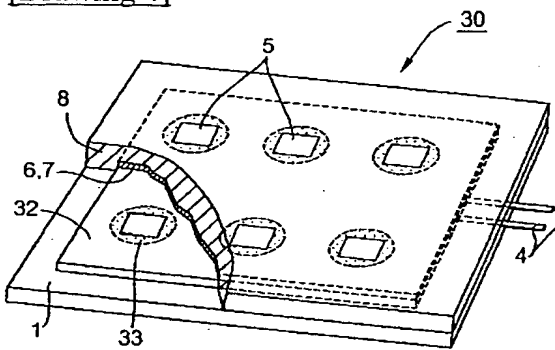
[Drawing 2]



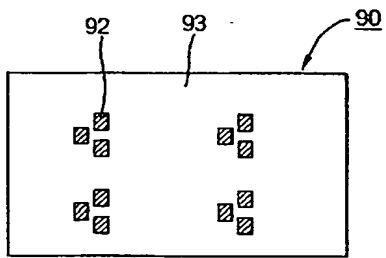
[Drawing 3]



[Drawing 4]



[Drawing 5]



[Drawing 6]

